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METHOD FOR OBTAINING A GOOD CONTACT SURFACE ON AN ELECTROLYSIS CELL BUSBAR AND BUSBAR

The invention relates to a method for forming a good contact surface on an electrolysis cell busbar used in the electrolysis of metals. The contact surface of the busbar i.e. the surface onto which the support bar or lug of the electrode to be immersed in the cell is lowered, is coated with a highly electroconductive metal. The invention also relates to an electrolysis cell busbar, on the surface of which a highly electroconductive coating is formed.

The fabrication of many metals such as copper, zinc and nickel, includes an electrolytic stage when the pure metal to be produced is deposited onto a cathode using an electric current, leaving the impurities in the solution. Electrolytic recovery is carried out for instance in electrolysis cells filled with an electrolyte containing sulphuric acid and electrodes (anodes and cathodes) made of electroconductive material are immersed in turn in the electrolyte. The electrode is suspended in the electrolysis cell by means of support bars or lugs, which are supported on the edges of the cell.

Electrolysis cells are connected in groups in series so that the anode of the previous cell is connected electrically to the cathode of the next cell by a busbar on top of the wall between the cells. The busbar is generally made of copper or at least copper-coated. The construction also typically includes a notched insulating bracket that goes on top of the busbar, which separates the cathode of the preceding cell from the anode busbar of the following cell. One end of the electrode support bar is placed on top of the busbar and the other usually on top of the insulating bracket. The metal to be produced is brought to the process either as a soluble anode, termed an active anode (electrorefining), or the metal is dissolved in the electrolyte, in which case the anodes are insoluble or passive anodes (electrowinning).

The geometry of a busbar may vary. An continuous busbar triangular in cross-section is described for instance in US patent 3,682,809. In other cases, the placing of electrodes in the cell is arranged by means of the design of the busbar. This kind of busbar is presented e.g. in US patent 4,035,280, where the electrodes are placed on bevelled grooves on the edges of the busbar.

US-patent 6,342,136, on the other hand, describes a main busbar that is continuous in the longitudinal direction, and equipped with protrusions of different heights, between which an insulating profile is placed. One end of the cathode support bar is placed on top of the main busbar and the other end is set on top of a copper potential balancing bar, which is on top of an insulating profile. When the busbar is continuous, the support bars or lugs of the electrodes can be set down on top of the desired point of the bar. In this way the whole busbar can act as the contact surface for the support bar or lug. If the busbar is notched or otherwise shaped so that the positions of the electrodes are determined, the notches or shaped points act as the contact surface of the bar.

The rapid wear of the contact surface is a problem with copper busbars. This is mainly due to the oxidation of copper into oxide and the corrosion of oxide into copper sulphate under the effect of the electrolyte. Copper sulphate formed on the contact surface further weakens the electrical conductivity of the busbar and in addition, the copper sulphate dissolves into the electrolyte. Oxidation brings about an increase in voltage drop, because the electrical conductivity of copper oxide is significantly weaker than that of pure copper. In addition, the copper dissolving from the busbar in zinc electrolysis for example raises the copper level in the cathode zinc unnecessarily.

Now a method has been developed, which relates to the attainment of a good contact surface on an electrolysis cell busbar used in the electrolysis of metals, where at least the surface part of the bar is made of copper.

According to the method now developed, the area of the busbar onto which the electrode is lowered, the contact surface, is coated with a highly electroconductive metal or metal alloy such as silver or silver alloy. The copper and silver are attached to each other by means of a transmission layer. When a metallic joint is formed between the transmission layer formed on the copper of the busbar and coating material, the problems caused by wear or oxidation of the lower surface of the contact piece are avoided. The invention also relates to a busbar fabricated by means of the method, for use in electrolysis cells in the electrolysis of metals, where at least the point which comes into contact with the electrodes, the contact surface, is formed of a highly electroconductive layer. When the term busbar is used in the text, it also means a potential balancing bar mentioned in the prior art.

The features presented in the claims are characteristic of the invention.

It is important that the contact surface in the busbar conducts electricity well. The use of a highly electroconductive metal such as silver or silver alloy as coating material ensures an effective feed of current from the busbar to the electrode. The metallurgical principle for the use of silver is that although it forms oxides on the surface, at relatively low temperatures the oxides are no longer stable and decompose back to the metallic form. For the above reasons oxide films do not form on the silver plating made on contact surfaces of a busbar in the same way as they do for example on a copper surface. Coating helps ensure that the electrical quality level of electrolysis also remains high for long periods of time.

Silver does not form a metallurgical, very adhesive joint directly on top of copper, so instead a thin transmission layer has to be formed on the copper first, preferably one of tin or a tin-dominant alloy. Hereafter in the text for the sake of simplicity we shall refer only to tin, but the term also covers tin-dominant alloys. Tin layers can be formed in many ways as beforehand by tin coating through heating, electrolytic coating or by thermal spraying

directly on the surface point before the actual coating. After this, the tin surface can be coated with silver or silver alloy. The coating with silver of the copper contact surface of the busbar can be carried out advantageously for instance with thermal spraying or soldering technique.

Oxidations are removed from the section of the busbar acting as contact surface before the coating is formed. It is advantageous to carry out the procedure on new bars too, but particularly when the method is applied to improve the electrical conductivity of used bars, the removal of oxidation is necessary. Removal can be done for instance by sandblasting.

The method of coating busbars depends to some extent on the geometry of the bar. When the busbar or potential balancing bar is continuous in the longitudinal direction, coating is applied along the whole length of the bar and in that case it is preferable to do the coating by means of thermal spraying technique, although of course soldering technique can also be used. If notches or grooves have been formed on the busbar as contact surfaces for the electrodes, it is naturally not worth coating areas other than these contact surfaces. In these cases too, soldering technique is an advantageous method of forming the coating.

Thermal spraying technique can be used to coat the busbar with silver, since the melting point of silver is 960°C. An AgCu alloy can also be used as coating material e.g. in the form of wire or powder. The melting point of eutectic AgCu alloy is even lower than that of silver and therefore is suitable for contact surface coating with the technique in question.

Out of the thermal spraying techniques available, in practice at least the techniques based on gas combustion have proved practicable. Of these, High Velocity Oxy-Fuel (HVOF) spraying is based on the continuous combustion at high pressure of fuel gas or liquid and oxygen occurring in the combustion chamber of the spray gun and the generation of a fast gas flow

with the spray gun. The coating material is fed into the gun nozzle most often axially in powder form using a carrier gas. The powder particles heat up in the nozzle and attain a very high kinetic speed (several hundreds of metres per second) and are directed onto the piece to be coated.

In ordinary flame spraying, as the mixture of fuel gas and oxygen burns it melts the coating material, which is in wire or powder form. Acetylene is generally used as fuel gas due to its extremely hot flame. The coating material wire is fed through the wire nozzle with a feed device using a compressed air turbine or electric motor. The gas flame burning in front of the wire nozzle melts the end of the wire and the melt is blown using compressed air as a metallic mist onto the piece to be coated. The particle speed is in the order of 100 m/s.

Thermal spraying technique melts the surface material and since the molten droplets of the silver-bearing coating have a high temperature, a metallurgical bond is generated between the copper, tin and coating material in the coating of the contact surface of the busbar. Thus the electrical conductivity of the joint is good. The metal joining method gives rise to a eutectic of the ternary alloy of silver, tin and copper in the joint area e.g. in a temperature range of 380 – 600°C. If necessary, separate heat treatment can be carried out after spraying, which promotes the formation of a metallurgical joint.

When soldering technique is used to form a coating on the contact surface of the busbar, the surface to be treated is cleaned and a tin layer is formed on it, preferably less than 50 μm thick. Then the silver coating is carried out with some suitable burner. The tin layer melts and when the coating sheet is placed on top of the molten tin, it is easy to position in the correct place.

The method also relates to a busbar or potential compensating rail used in an electrolysis cell. A highly electroconductive layer is formed on the copper

surfaces of the busbar, particularly on those contact surfaces, which come into contact with the electrode support bar or lug. For a highly electroconductive metal or metal alloy, silver is used, or a silver alloy such as silver copper. The coating of the contact surface is preferably carried out e.g. by soldering or thermal spraying technique, where a metallurgical joint is formed between the contact surface and the coating. If the busbar is longitudinally continuous, it is preferable to coat it along the whole length of the busbar. If contact surfaces are made on the bar with notches or grooves for electrodes, then only these contact surfaces are coated according to the invention.

The method according to the invention is described further with the following example and the attached Figure 1,
which shows the relative voltage drops in both an electrolysis cell busbar according to the invention and in reference bars.

Example
Three electrolysis cells in copper electrolysis (electrorefining) each had 81 electrodes, of which the contact surfaces coming to the busbar were conventionally made of copper. One of the cells was equipped with an embodiment of the present invention, where the contact surface of the cell busbars was coated with silver. The other two cells had normal copper busbars. Figure 1 shows that the voltage drop of the silver-coated bars is much smaller than that of the conventional busbars. The voltage drop is calculated as an average of the electrodes. The worst cell busbar voltage drop is taken as the value of 100 and the voltage drop of the busbars in the other cells is reported in relation to this.